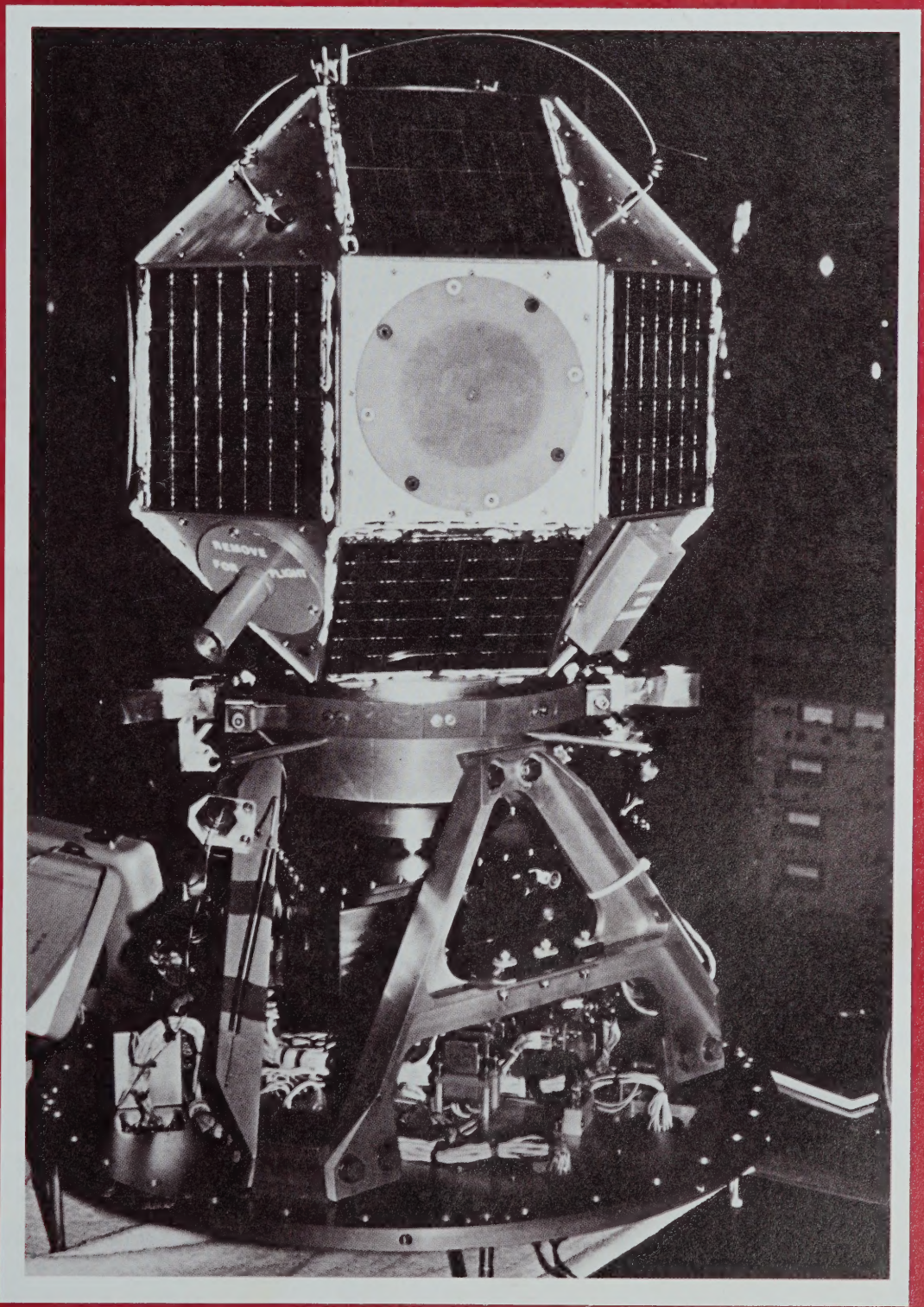
AMSAT

SATELLITE JOURNAL

Journal of the Radio Amateur Space Program

May-June 1985, No. 4



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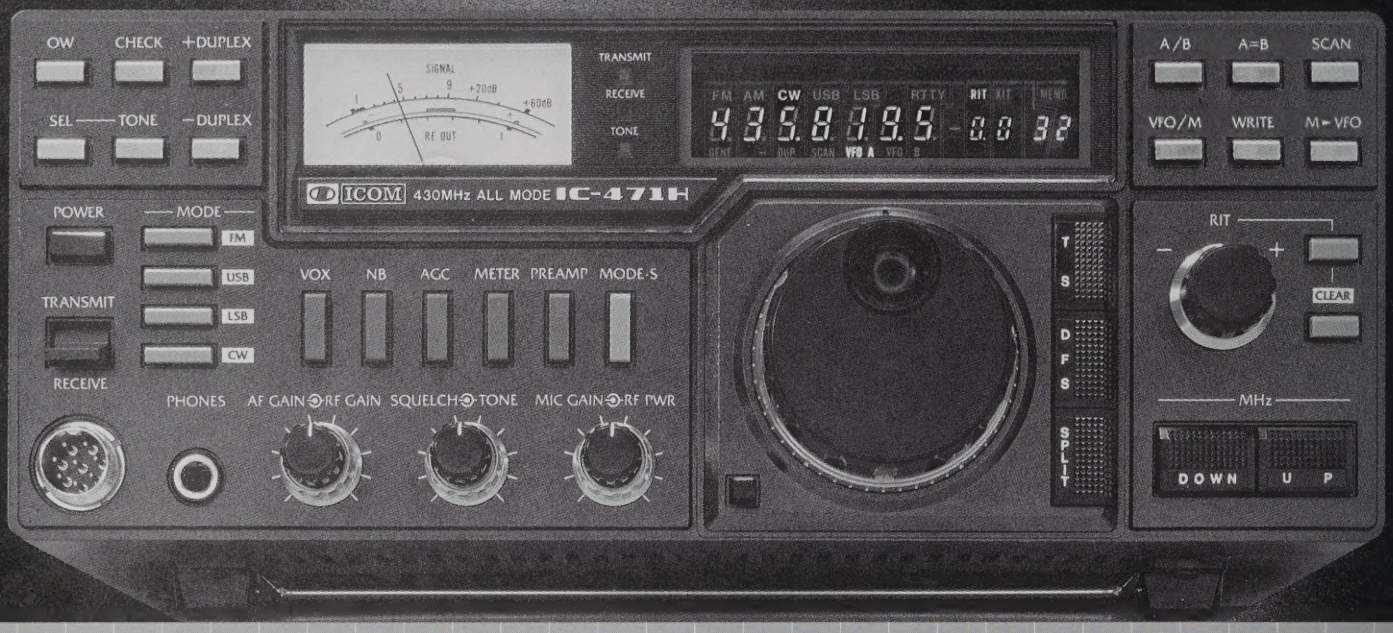

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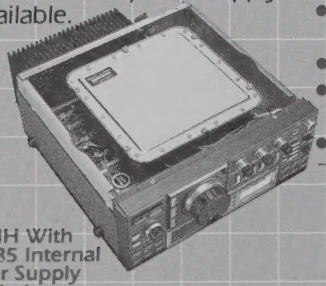

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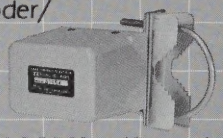

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CONTENTS

On the cover: The NUSAT (Northern Utah Satellite) spacecraft is affixed to the mounting mechanism that ejected it from the space shuttle's Get-Away Special (GAS) cannister. The satellite project was headed by Weber State College (Ogden, Utah). The AMSAT/VITA digital satellite, PACSAT, will be launched from the shuttle using a similar system. (Phil Karn photo)

PERSPECTIVE

One of the satisfying parts of any editor's job is reading comments from readers, most especially the nice ones. Since *Satellite Journal*'s first issue earlier this year, there has been a gratifying response to the format and content of this publication. To those who wrote and to the many others who relayed their compliments by word of mouth, a very sincere thanks. As other active participants in AMSAT activities will tell you, the only return we often get for the investment of our time and effort is the satisfaction of knowing that the work is appreciated.

Along with the comments have been some suggestions. For example, John M. Franke, WA4WDL, of Norfolk, Virginia points out that call letters are assigned to stations and not to people. He asks that references to amateur radio operators include their names in addition to their stations' call signs. John also asks that *Satellite Journal* provide information that will help the newcomer to satellites get the most out of his or her pursuits.

Both of John's suggestions are well-taken. You will notice that a conscious effort has been made in these pages during our first four issues to serve the needs of the neophyte. A special column is devoted to helping the newcomer, and all regular columnists provide information to help the first-time satellite communicator. In addition, we will have features, technical and otherwise, of interest to the experienced as well as the fledgling bird user.

John was also kind enough to pass along some very interesting information from the pages of the *History of Rocketry & Space Travel* by Von Braun and Ordway. Those two authors point out the importance of a magazine as a unifying force in an organization, especially a technical group such as the British Interplanetary Society. The first president of the BIS, P.E. Cleator, tried to convince the membership of the vital role played by the society's magazine, the *BIS Journal*. He editorialized in April 1934:

"The tremendous importance of a substantial and interesting Journal was brought home to me during my conversations with the German experimenters. In the year 1929, the old German rocket society . . . ceased the publication of their Journal, *Die Rakete*. The immediate result was the loss of over 600 members! It happened like this: there came a time when the Society had to choose between publishing the Journal and carrying out certain important and costly experiments. Eventually, it was decided to sacrifice the Journal. Now the new programme was all very well for those members who happened to live in Berlin, for they could take part in, or witness, the experiments. But not so for the majority of members, who were scattered throughout the country. With the loss of the Journal, they were deprived of their only real link with the Society. The moral is clear. The journal of a Society constitutes a vital connecting link. . . . The Journal must come before experimental work."

Certainly AMSAT is not in a "guns-or-butter" situation. Experimentation and new satellite construction are indeed proceeding, even as this magazine is being published. Work has begun in Colorado and Washington, DC, on development of the Phase IIIC spacecraft. And in a couple of months, the PACSAT packet-radio satellite will start to take shape. The above quote merely points out the importance of a magazine as a carrier of information to those not able to participate directly in satellite construction and as a unifying force within the AMSAT organization.

Another letter recently received came from Ralph Lindberg, N7BSN, of Keyport, Washington. After seeing an *Orbit* magazine cover photo of the helicone antenna installed at OE1VKW, Viktor Kudielka's station in Vienna, Austria, Ralph did some research. He writes:

"I found the helicone described in *Electromagnetics* by John D. Kraus and Keith R. Carver, with credit given to Carver's paper in the *Proceedings of the IEEE* 55:559 (April 1967). The antenna's gain is 20 dBi with an effective aperture of 3.2 wave. The antenna is said to be equivalent to a 31-turn single helical beam or a quad array of 8-turn helices."

According to Ralph, for a 19-turn helix, the cone should be 3.6 wavelengths in diameter at the open end tapering to ¾ wavelength at its base. The overall length should be 4.5 wavelengths. If anyone builds the antenna for use with the satellites, we would appreciate hearing the results of your tests.

Another AMSAT member, Ron, WA5RON (You need a magic genie to have that type of luck with a call sign.), writes "As one who did not want to see *Orbit* change. I can say that I am not disappointed in the new *Satellite Journal*. It certainly looks first-rate." Ron, an Austin, Texas resident, is looking for a copy of *Orbit* No. 5 to complete his collection. Can any one help?

If you would like to express your feelings, good or bad, please write. If there are enough letters, they will have a column of their own.

Harold Winard, KB2M

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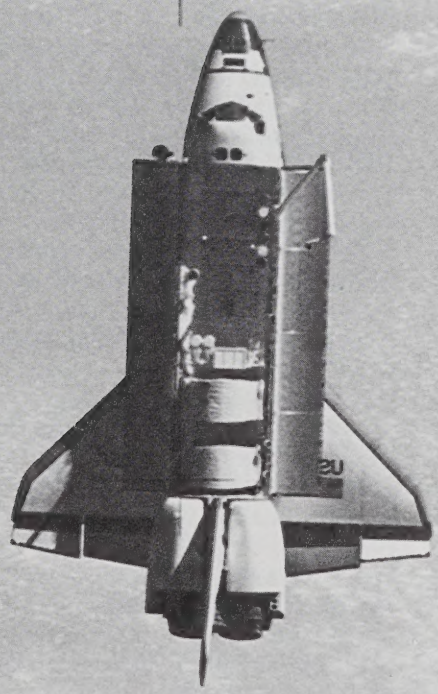

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Starting Out: A Beginner's Guide

By Andy MacAllister, WA5ZIB*

Making satellite contacts just for the fun of talking is fine, but for many, collecting QSL cards acknowledging those contacts adds to the enjoyment and documents the accomplishment.

The basics of QSL cards have been covered by others, but there are a few added twists to the procedure for confirming a satellite contact. There is more than one way to send and receive cards for such contacts, ranging from the expensive direct method to the more simple bulk shipment via QSL-card bureaus. Each has advantages and disadvantages and the best way is one that has to be individually considered.

For the newcomer, the most obvious way to send and receive cards is direct. The card is prepared with the necessary information and then sent to the home address of the other station. The address can be requested during the contact or obtained from a recent issue of a callbook. In addition to the time-honored *Radio Amateur Callbook* with its North American and overseas listings, the American Radio Relay League (ARRL) offers a United States edition. Although the books can be rather expensive, and postage is more costly than ever, sending QSL cards directly to the other station is the fastest and most reliable way to get results.

For that very important card that you really must have, a self-addressed, stamped envelope (SASE) to a domestic station or an envelope with an International Reply Coupon (IRC) to a foreign operator will really help. In addition, many rare DX stations have western European or American QSL managers, so the cost and response time using an SASE or an IRC can be reduced accordingly.

The IRCs cost 65 cents each in the United States and are redeemable for one unit of surface postage in most countries. For an airmail reply, more than one IRC will be necessary. A callbook will have details of the procedure for sending IRCs and most large post offices have them available for sale.

If you have a large number of cards for hams in a particular country, it may be appropriate to send them directly to that country's QSL bureau. For example, all Russian cards go the P.O. Box 88 in Moscow, regardless of any local or national forwarding services. Cards to Japan's many amateur operators are handled quite well by the country's national QSL bureau, so consider that alternative.

To find the address of a foreign QSL bureau, look in a callbook. A half ounce of cards will go airmail anywhere in the world for 44 cents. The rates are less to some areas of the western hemisphere, so check with your local post office first.

The ARRL has an outgoing QSL-card service for its members and an incoming system for all U.S. and Canadian hams. The organization will forward a pound of cards to almost anywhere for just one dollar. A list of countries that are not served by the ARRL, and further details on the outgoing operation, can be found on page 61 of the March 1985 issue of *QST*.

If you make any DX contacts at all, cards will eventually show up via the ARRL Incoming Bureau. To get those cards, make sure a supply of SASEs is on file with the bureau serving your district. Bureau addresses can be found on page 67 of the December 1984 issue of *QST*, or you can send an SASE to the ARRL QSL Bureau, 225 Main St., Newington, CT 06111 for information on how the system works.

AMSAT supports a QSL bureau with some unique features. It has both an incoming and outgoing operation, but it also operates for cards from one U.S. ham to another. Most active AMSAT members keep a few #10 envelopes on file, with appropriate postage attached, for any cards that may come in from overseas or from local satellite users.

For information on the AMSAT QSL bureau, or to send donations or SASEs, contact Perry Yantis, WB8OTH, 1850 Lisle Ave., Obetz, OH 43207. All cards that are sent to Perry should be sorted by prefix. Some foreign hams have envelopes on file but the rest are forwarded to the foreign bureaus each month via surface mail. The service is very efficient and includes a computerized system for handling foreign bureau mailing labels and the organization of unclaimed cards. Remember though that the AMSAT bureau is for satellite contacts only.

Cards are never thrown out at the AMSAT QSL bureau, so it is not too late to send some envelopes to Perry. Don't forget to put your call sign on the upper left-hand corner of the SASEs you send.

Expect between 65 and 75% reply for your efforts to secure satellite-contact QSL cards. Stations in the rare countries and the less populated states in the U.S. handle QSL cards more frequently so you may find that your return rate will be higher from them.

For many, the move to satellite activity is like starting ham radio all over again. Your first satellite contact can have as much impact as your very first ham contact. There are some very challenging awards and certificates available to the satellite enthusiast and QSL cards are almost always required. Best of luck in your efforts. And if you work me on AMSAT-OSCAR-10, remember that I "QSL 100%."

*2310 Romayor Court
Pearland, TX 77581

What's Your Opinion?

Do you have an opinion on some aspect of the amateur-radio space program? Would you like to share it with other space enthusiasts? Send your opinions, typewritten and double-spaced, to Satellite Journal, P.O. Box 575, Wharton, NJ 07885. To give as many people a chance to have their thoughts put into print, please limit yours to one or two paragraphs.

Worldwide Satellite Operation

by Ray Soifer, W2RS*

In the last issue, I promised a further discussion of the Mode K 15-to-10-meter transponders that are expected to fly in the Soviet RS-9 and RS-10 satellites, now scheduled for launch in December. Both satellites will also contain Mode A and robot transponders similar to those in the present RS-5 through RS-8 series. In addition, they are expected to be placed into orbits similar to those of their predecessors.

The most recent information received from Pat Gowen, G3IOR, gives the uplink passband as 21.260 to 21.300 MHz and the downlink as 29.460 to 29.500 MHz. The robot transponder is expected to have an uplink frequency of 21.140 MHz and a downlink on either 29.457 or 29.503 MHz.

The concept of an all-HF satellite transponder has generated a controversy among planners and designers of amateur-radio satellites. AMSAT considered several proposals along such lines in the 1970s, but limited resources and a strong inclination toward UHF development by the technical groups (who, after all, would have had to do the work) resulted in those proposals never being implemented.

Some years ago, I prepared a rather lengthy analysis of the regulatory status, propagation paths, and ground station requirements for all available amateur satellite bands, including 21 MHz. It was published by the American Radio Relay League (ARRL) in the *Proceedings of the ARRL Technical Symposium on Space Communications* (Sept. 14, 1973, pp. 101-127).

Without reproducing the entire analysis, the principal advantages of 15 meters as an uplink band are the very low power requirement for the ground station—as much as 40 times (16 dB) less than Mode A, which should preclude the need to elevate 21-MHz antennas—and the extremely large number of potential users. At 21 MHz, as little as 3 W EIRP can produce a fully usable −100 dBm signal at the satellite, assuming a 4000-km slant range. The principal disadvantages are a greater ambient noise level than at higher frequencies, the possibility of ionospheric absorption or blockage, and a significant likelihood of unintentional access to the satellite by stations engaged in terrestrial operation.

The Soviets have always tried to enable access to their satellites by as many amateurs as possible. They did this by making ground station requirements as minimal as they could. Thus, it comes as no surprise that they have decided to include Mode K in their next Radio Sputniks. Actually, both satellites in the Ishkra series had been reported to contain Mode K transponders, but they did not function for other reasons.

Because of the possibility that stations outside line-of-sight satellite range might gain access to the satellite through ionospheric skip, a 21-MHz uplink should prove most interesting to those trying to complete their Phase II Satellite DXCC awards. Although I have heard some people claim that the trough of the sunspot cycle—1986 and 1987—will see a dead 21-MHz band, those people are obviously not DXers. I spent half of 1965 operating from an apartment in Beverly Hills, California, with a barefoot transceiver and a 15-meter whip out the window, making WAC rather easily. Logs for that period show 21 MHz open for as much as 15 hours per day.

This is 1985, of course, and not 1965, so I decided to run a computer simulation on my trusty Apple IIe using the DX-1 software package produced by DX Enterprises of San Jose, California. Two locations were selected:, those of W6SP and UA3CR. For each location I predicted the number of hours that 21 and 29 MHz would be open each day to somewhere under typical sunspot-minimum conditions—a 10.7-cm solar flux of 70 and a geomagnetic A index of 3. That was tried for four calendar dates and the results were as follows:

Daily Hours of Opening at 21 and 29 MHz

Date	W6SP		UA3CR	
	21 MHz	29 MHz	21 MHz	29 MHz
21 Mar	17	9	13	3
21 Jun	18	7	17	7
21 Sep	17	7	13	3
21 Dec	17	8	11	1

Those DX-1 simulation results include only F2-layer propagation; the sporadic-E effects that occur frequently during summer months should produce even more skip into and out of the Mode K transponders. In addition, ionospheric scatter will extend the satellites' usable range, even at times when skip is not available.

Any experienced Mode A user has observed countless times when he or she could hear the downlink for several minutes before uplink acquisition of signal (AOS) and after uplink loss of signal (LOS). In Mode K, that scatter effect will be present on both uplink and downlink, enabling two-way access well beyond normal range.

Thus far, six amateurs have earned Phase II Satellite DXCC. If I am right, Mode K has the potential to expand that number substantially. Along with separate antennas, get your independent 21-MHz transmitter and 29-MHz receiver ready now!

In my next column, I shall return to the usual reader-contributed format. Keep those cards and letters coming!

*60 Waldron Ave.
Glen Rock, NJ 07452 U.S.A.

Call for Nominations

AMSAT Headquarters announces that nominations for the office of member of the Board of Directors are now in order. The seats of four directors—John Henry, VE2VQ, Jan King, W3GEY, John Browning, W6SP, and John Pronko, W6XN—are up for election in this cycle. Last November three directors (Thomas Clark, W3IWI, Vern Riportella, WA2LQQ, and Harry Yoneda, JA1ANG) were elected. The term of office is two years.

An AMSAT member who agrees to serve can be nominated by any five current AMSAT members or by an AMSAT member society. Nominating petitions may be sent to: AMSAT, 850 Sligo Ave., Silver Spring, MD 20910.

Petitions must arrive at AMSAT not later than July 31, 1985. Nominees will be asked to provide minimal background and biographical data for inclusion with the ballot forms.

The Digital Front

by Harold Price, NK6K*

It will probably be at least 18 months until the PACSAT satellite is ready to go. But if you can't start your day without copying some bits from space, don't worry. There is a lot of interesting digital action already available.

The digital satellite that is easiest for you to hear with minimal equipment is probably UoSAT-OSCAR-9. The satellite was designed and built by amateurs and others at the University of Surrey in Guildford, England and includes several scientific experiments on board as well as a continuous FM beacon transmitting at 145.826 MHz.

The beacon contains ASCII data sent using 1200 and 2400-Hz tones. That's close enough to the Bell-202 standard for use by many off-the-shelf 202-type modems. I have used several different types of surplus modems costing less than $30.00. On most days, OSCAR-9 sends 60 channels of telemetry in strings of five-digit numbers. Once received and recorded, they are easily decoded by hand or by using a simple computer program. On weekends the telemetry is mixed with clear-text bulletins concerning amateur satellite activity.

Talking satellite

In addition to the text bulletins, the spacecraft contains a voice synthesizer chip, known commercially as a Digitalker. The synthesizer is usually used to read five of the more important telemetry values. For best results, a multi-element steerable antenna should be used, but I have heard the Digitalker clearly with a hand-held rig and a rubber-duck antenna. The beacon transmits with 200 mW from its 500-km high orbit.

The other satellite in the UoSat series, UoSAT-OSCAR-11, carries a prototype PACSAT communications package in addition to a complement of scientific experiments. The prototype, called the Digital Communications Experiment, or DCE, was discussed in this column last March.

With a nod to the codestore experiment on OSCAR-6, which stored a small number of bytes for transmission in Morse code, OSCAR-11 is the first amateur satellite equipped to demonstrate store-and-forward message switching from a low earth orbit. Like its predecessor, OSCAR-9, OSCAR-11 downlinks data using FM at 145.825 MHz. Although this might appear as if the two satellites would interfere with each other, OSCAR-9 comes overhead about 3:00 local time and OSCAR-11 at about 9:30.

OSCAR-11's telemetry format is similar to that of OSCAR-9, but the former has several on-board experiments that make its downlinked telemetry interesting, the charge-coupled device (CCD) camera for example. The ground station equipment required is the same for both satellites with just two exceptions. Since the UoSat project is headquartered in the United Kingdom, British users expressed two complaints about OSCAR-9. First, the Digitalker speaks with an appalling midwest American accent. Also, the sense of the mark and space data tones was reversed from the standard set used by a popular microcomputer in the UK.

The UoSat team set out to right these wrongs, with the result that the data tones for OSCAR-11 are upside down from the Bell-202 standard. In addition, the Digitalker sounds like a BBC announcer with more than just tea in his cup.

Thus, to copy OSCAR-11 data, you will need to invert the data stream at some point before it reaches the UART in your terminal or computer. That is not as big of a problem as it sounds, and the solution will be left to the reader. However, I will collect a few schemes and discuss them in a future column. One more hint for advanced students: if you have a terminal node controller (TNC), you should already have a Bell-202 modem. The modem disconnect jack on the TAPR TNC can be used to pick off a TTL data stream from demodulated Bell-202 tones. Also, a suitable modem is described in the 1985 *ARRL Handbook*, page 29-15.

To round out our discussion of digital data from space, let me remind you of AMSAT-OSCAR-10. There are three items of interest on that bird, the RTTY beacon, the PSK beacon, and the SSC L1 channel. The Mode B general beacon gets the most air time, and can be found near 145.81 MHz. The RTTY format was described in detail in the January issue of *Satellite Journal.*

A good description of an easily reproducible modem and decoding system for the PSK portion of the OSCAR-10 beacon has not been published. *(For a new design, see Ham Radio, April 1985, Ed.)* That statement requires a bit of qualification. JAMSAT, the Japanese satellite group, has developed a modem, but information on it is not readily available here yet. Also, real history buffs will recall an article on the Phase III telemetry system in the June 1979 *AMSAT Newsletter*. There was also a two-part article on PSK demodulators in *Orbit* #5 and #14.

The OSCAR-10 SSC L1 channel is coordinated for use by 1200-baud packet radio using the AX.25 protocol. A complete discussion of activity on that channel has been provided in a user's guide published by Hank Magnuski, KA6M. Full scale use of the channel awaits development of a better modem, but good results are possible using Bell-202 modems and AFSK modulation. Although the published location of the SSC L1 channel is 145.830, in practice 145.832 is used, as the edge of the transponder is too close to the former frequency. Data has been exchanged between several countries and stations are active throughout North America. New stations are coming on-line every week in West Germany, New Zealand, Australia, and elsewhere.

A few words

Finally, a few words about the intended scope of this column. Several good newsletters, magazines, and handbooks are available that describe packet radio, supplying both technical and news-of-the-day items. The Digital Front will look at developing packet radio technology from the satellite perspective. The OSCAR-11 DCE, PACSAT, and the upcoming JAS-1 and Phase IIIC spacecraft will give us plenty to talk about. Although I'll try to give the minimum background required to understand what's discussed, for best results you should do a little background reading. There may be a pop quiz later. A good place to start is the 1985 edition of the *ARRL Handbook*.

Packet radio is also described in a series of articles in *Ham Radio Magazine*, July and August 1983, and in a three-part series in *73 Magazine*, September and October 1983 and January 1984. A good introduction to PACSAT from the computer point of view appeared in *Byte* magazine's May 1984 issue, in an article entitled "Bulletin Boards in Space."

For news, I recommend the ARRL packet-radio newsletter, *Gateway*, published every two weeks. A more technical newsletter is published every two months by the Tucson Amateur Packet Radio Corporation (TAPR). Almost every major metropolitan area now supports a packet radio club and most have excellent newsletters. Compuserve, a computer-based information service, has a ham radio bulletin board called HAMNET, which has a very active packet radio subnet. Type GO HOM-11 to get access.

More on UoSAT

The most complete summary of OSCAR-9 is contained in the August/September 1982 issue of *The Radio and Electronic Engineer*, a British journal. Additional information has been compiled by the UoSat team into a number of datasheets:

Newsletter—General Status of UoSAT Activities as of June 1984
Datasheet 1—UoSAT Project Summary
Datasheet 2—UoSAT-1 Technical Data Summary
Datasheet 3—UoSAT-1 Orbit Geometry, Tracking, and Ground Station Details
Datasheet 4—UoSAT-1 Telemetry
Datasheet 5—UoSAT-2 Project Summary
Datasheet 6—UoSAT-2 Technical Description
Datasheet 7—UoSAT-2 Reception, Data Formats, and Telemetry Equations
Datasheet 8—UoSAT-2 FSK Demodulation using the BBC Microcomputer

Send your request for information to: UoSat Team, University of Surrey, Guildford, Surrey GU2 5XH, England.

** 1211 Ford Avenue*
Redondo Beach, CA 90278

de K2UBC

by Martin R. Davidoff, K2UBC*

It's difficult to sit down and write about a satellite until its construction or day-to-day operation become routine. With UoSAT-OSCAR-11, or UoSAT-2 for short, very little has been routine. Designing, constructing, and testing a complex radio amateur spacecraft in six months is impossible. Luckily, no one in the UoSAT Spacecraft Group at the University of Surrey (Surrey, England) knew that, so UoSAT-2 was delivered on schedule in time for its successful launch on March 1, 1984.

You're probably familiar with the events that followed—the loss of command capabilities on orbit 3; the determined efforts, often under extremely discouraging conditions, to regain control; and the successful recovery on May 15, 1984. Since that time, the spacecraft has been stabilized and the major mission experimental modules tested—all seem to be in good working order. UoSAT-2 is a healthy bird with an excellent prognosis and it should be around for quite some time.

Although UoSAT-2 does not contain an open-access transponder, it has several systems of interest to radio amateurs. They were described by the project manager, Martin Sweeting, G3YJO, in a pre-launch article in *Orbit* (Jan./Feb. 1984). For reference purposes, I have compiled some information on UoSAT-2 that may be of use to readers of *Satellite Journal.*

What's in a name?

Its pre-launch designation was UoSAT-2 or UoSAT-B, and to the amateur world it's OSCAR-11, but once in orbit, the satellite received the international designation 84-Ø21B. The spacecraft was hurled into orbit by a Delta 3920 launch vehicle that rose off a pad at the NASA Western Test Range in Lompoc, California.

The bird is in a nearly circular polar orbit and reaches a maximum altitude, or apogee, of 693 km. At perigee, the satellite comes to within 675 km of the surface. The maximum access distance, also called the slant range, is 2846 km.

Rectangular, UoSAT-2 measures 58.5 cm high and 35.5 cm on a side. Like its predecessor UoSAT-OSCAR-9, the spacecraft's base—the side with the launch fitting—has a "wing" extending about 16 cm. Two SHF helical antennas are mounted on the lower side of the wing and the navigation magnetometer and space dust experiments are mounted above the wing. In all, the satellite's mass is just over 60 kg.

Signals to Earth

There are three beacon transmitters on board UoSAT-2, one each at VHF, UHF, and SHF. The VHF beacon, nearly identical to the unit that now flies in UoSAT-1, transmits at 145.826 MHz using a nominal output of 400 mW and narrowband FM. The maximum Doppler shift you're likely to see from this beacon is 3.6 kHz.

The UHF beacon has 600 mW at its disposal and sends its signal down on 435.025 MHz. Again, FM

COMET

Looking for another challenge? Tom Hall, N6DGK, was and found it in mobile satellite operation. His compact car sports two antennas, one for the Phase II 2-meter uplink and the other for the 10-meter downlink. The equipment consists of a Yaesu FT-77 HF transceiver for receiving and an FT 290R rig driving an amplifier to 70 W for the uplink. Tom says his simple mobile station has made many mobile contacts through the Russian RS series satellites, many with good signals both ways.

Publisher Wanted

AMSAT is soliciting applications for the position of volunteer publisher of *Satellite Journal.* The most qualified applicant should be a radio amateur with experience in business, preferably publishing. He or she should be capable of handling an important and highly visible position within the AMSAT organization and the amateur-radio community.

Responsibilities of the position include administration of advertising sales efforts, management of the magazine's budget, and policy determination in concert with the editor and key AMSAT officers.

Remuneration includes a sense of accomplishment in helping further the goal of AMSAT to provide reliable satellite facilities and services to radio amateurs. It also includes valuable experience in the administration of an important, technically oriented publication, as well as an opportunity to learn and help the amateur-radio manufacturing and sales industry in the U.S. and abroad.

Send applications to Satellite Journal, P.O. Box 575, Wharton, NJ 07885, USA. Include a description of work experience, amateur or professional, that would relate to the position.

is used for audio frequency-shift keying (AFSK). The maximum change in frequency that will be sensed by a ground station as the satellite moves across the sky is 10.5 kHz. The beacon uses a phase-locked synthesizer of recent design.

Designed by Colin Smithers, G4CWH, the SHF beacon transmits at 2.4015 GHz with 500 mW. As with the UHF beacon, the microwave transmitter sends data using AFSK but has facilities for PSK. The maximum Doppler shift at this frequency is 57.8 kHz.

The spacecraft has several subsystems that help keep it properly oriented in orbit. The navigation magnetometer, for example, is a three-axis flux-gate device that permits an accurate determination of the satellite's attitude. Such information is important for the magnetorquers, an arrangement of six coils, also mounted in three axes, one around each edge. Sending a pulse of current through the magnetorquers at the proper moment exerts a force against the Earth's magnetic field, helping to reorient the spacecraft.

Also instrumental in keeping the UoSAT-2 properly aligned is the gravity-gradient boom, which was successfully extended after launch. The 12-m long boom, which has a 2.5-kg tip mass, uses the Earth's gravitational field to force the satellite into facing one way with respect to the massive planet around which it orbits.

Power from the sun

Energy for the spacecraft's systems comes from an array of four solar cells attached to the four faces of the main framework. The arrays, manufactured by Solarex, each measure 49.5 by 29.5 cm. They provide charging current for a storage battery consisting of ten F-size nickel-cadmium cells in series. The battery provides 12 V at 6.4 Ah.

The power section includes three subsystems: the battery-charge regulator (BCR), a power conditioning module (PCM), and a unit called the power distribution module (PDM). The BCR, actually two redundant systems, accepts the 28-V level supplied by the solar arrays and provides the proper voltage and current to charge the battery. The PCM receives poorly regulated 12 to 14 V from the battery/BCR bus and converts it into regulated +10, 5, and −10 V for the spacecraft's systems and experiments. The PDM controls and monitors the power and safeguards on-board systems via latch thresholds set by ground controllers via telecommands.

The most important part of the control system is the Integrated Housekeeping Unit, or IHU. That microprocessor-based system is responsible for primary spacecraft control. It contains 48 kbytes of RAM, several serial and parallel ports, plus the Digitalker speech synthesizer with its vocabulary of 550 words stored in ROM.

The UoSAT-2 spacecraft is a complex system with many interesting experiments. I will review some of them, plus their results, in a future column.

* *13803 Manor Glen Road*
Baldwin, MD 21013

W 6 Space Philosopher

by John Browning, W6SP, Chairman of the Board*

In an earlier column (*Orbit* magazine No. 15), I discussed the triphased transition of gift categories associated with increasing age. Typical males progress from receiving exciting presents during youth, to getting a steady stream of neckties. They then receive ingenious gifts again when it becomes obvious the supply of neckties far exceeds lifetime requirements.

My initiation into Phase III has expanded my library of "how-to" books. Prominent among them is a small paperback titled, *How to Kazoo.* In spite of the distinct likelihood of its never becoming a classic, that particular book undoubtedly fills a real need somewhere. It was written by a lady, named Barbara Stewart, who cleverly convinced Workman Publishing Company to commit her words to print (and copyright) in 1983.

According to an article in the March 14, 1985 issue of the *Los Angeles Times*, the book *How to Kazoo* has sold 120,000 copies. The article includes a description of the recent successful organization of kazoo bands in senior citizen centers in our metropolitan area. Nearby neighbors would probably prefer neckties.

For those without ready access to the *Los Angeles Times* or to Ms. Stewart's best-selling volume, some explanation is in order. A kazoo, or tube merliton, is a primitive form of musical instrument akin to the more familiar comb-and-tissue-paper combination (free merliton). After reading the book, I would be quite comfortable going into a shop and purchasing a kazoo. Later, in the privacy of my shack, I could confidently commence practicing by humming (not blowing) into the big end. On the other hand, my buying a comb might be considered unseemly.

Anybody who undertakes a completely unfamiliar activity, including an avocation like amateur radio, needs similar basic guidance. There is plenty of reference information available but the problem is frequently one of "getting started." A certain elementary level of knowledge is essential to permit initial investigation of options for equipment acquisition and operation. The American Radio Relay League (ARRL) and other prominent international radio societies are quite responsive to the needs of prospective amateurs who want to get started on their own. As a recent example, Chapter 36 of the *ARRL 1985 Handbook for the Radio Amateur* is called, "How to Become a Radio Amateur." A cookbook format for beginners is provided. In Chapter 23, "Space Communications," the background and basics of amateur spacecraft use are covered in considerable detail.

AMSAT officials are frequently invited to make satellite presentations and to participate in forums at amateur clubs, conventions, and symposia. A typical audience is composed of hams with varying degrees of interest in and experience with space communications. It is difficult for the presenter to judge the correct level of information required to accommodate differing individual needs. To deal with this problem, I have adopted an evasive presentation technique. At the start of a session, I distribute a sheet giving a status summary of active and planned satellite programs. I then ask for questions concerning the information on the handout. The response has, in all cases, been enthusiastic and challenging.

At the recent ARRL Southwestern Division convention in Santa Maria, California, several participants engaged in a spirited discussion. A number of excellent ideas to improve amateur satellite operations were proposed. Those suggestions were presented in the traditional "why don't they" format. One of the technically well qualified attendees was Harold Price, NK6K. Harold got up and said, "Hey, don't forget, They is You! Volunteers have to do all these great things. You are AMSAT!" Harold always seems to be there when we need him most.

After politely considering Harold's wisdom, the group continued to focus on the thought, "We have a remarkably capable satellite in AMSAT-OSCAR-10. But its passbands are not crowded like amateur frequencies are supposed to be. In this period of declining sunspots and poor ionospheric propagation, more operators should be using the satellite. If people knew how easy and how much fun it is, we would gain new users and additional AMSAT members as well. Why don't 'they' have meetings to teach potential newcomers and why don't 'they' put out a 'How-to AO-10' book?"

The Santa Maria group was well informed about and satisfied with existing publications, such as AMSAT's *Amateur Satellite Report* and ARRL's *The Satellite Experimenter's Handbook*. But they perceived a shortage of help for the rank beginner.

I'm pleased to observe "they" are making some progress along the lines suggested at Santa Maria. For instance, an objective of the ongoing expansion of the list of AMSAT Area Coordinators being conducted under the auspices of Jack Somers, WA6VGS, is to improve information access for potential satellite users. One of the new coordinator appointees, Ross Forbes, WB6GFJ, recently hosted a successful, day-long users clinic in San Francisco. Emphasis was placed on providing basic information for beginning satellite operators. Similar gatherings will, no doubt, be arranged in other parts of the world.

So far, "they" have not put together a "How-to AO-10" book. There is no all-in-one-place tutorial tailored for satellite newcomers. In a couple of years Andy MacAllister, WA5ZIB, will be able to collate his "Starting Out: A Beginners Guide" column from back issues of *Satellite Journal* and produce the missing document. In the meantime, if any of "you" with the requisite experience and writing skills would like to become a "they" for the purposes of creating a complete beginners' guide, opportunity knocketh!

When the March 21, 1985 issue of the *Palos Verdes Peninsula News* appeared on my doorstep, I was not surprised to find most of page 3 devoted to an article about kazoos. The words and photos were provided by a *News* staff writer. It is safe to say he is not a *Los Angeles Times* subscriber. In researching the subject of kazooing in Palos Verdes, the writer admits to a lack of understanding of why our local music store is doing a windfall business with kazoos. He quotes an employee of the shop as saying, "It's really strange. We get a lot of people coming in for kazoos. They sell out as fast as we can get them." I wonder if Barbara Stewart lives here? 73, John, W6SP.

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Satellite Journal is the very best way for AMSAT to keep its readers informed about the latest developments in the radio amateur space program. It's a vital link to the satellite user that relies on the goodwill of its advertisers.

When you call or write one of those manufacturers or retailers, tell them you saw their advertisement in *Satellite Journal*. You'll help demonstrate the importance of the satellite community and also ensure our continued growth and service to the membership.

AMSAT NEWS

ARRL Foundation Votes Phase IIIC Funds

The ARRL Foundation has voiced its support for AMSAT's Phase IIIC satellite project and backed its statement with a grant of $10,000. The grant comes in the form of matching funds and will be made available in two payments of $5000 each upon confirmation that AMSAT has met its part of the obligation.

In a letter to Foundation president Paul Grauer, WØFIR, AMSAT president Vern Riportella, WA2LQQ, expressed the organization's "gratitude for the Foundation's steadfast support of the amateur space program and its ideals as manifested, in part, by the construction and launch of Phase IIIC."

The Phase IIIC project, a joint effort of AMSAT and AMSAT DL, seeks to launch an advanced version of the AMSAT-OSCAR-10 satellite by mid 1986. The ARRL Foundation, Inc. is a separate entity established by the American Radio Relay League (ARRL) for the advancement of amateur radio. The Foundation provided a matching fund for the Phase IIIA project.

Donations for the matching fund should be sent to AMSAT, P.O. Box 27, Washington, DC 20044. When the first $5,000 increment is attained, AMSAT will apply to the Foundation for the first $5,000 grant.

AMSAT DL Specifies Mode L Packet System

Plans for the digital communications transponder aboard the Phase IIIC satellite call for compatibility with the present AX.25 standard and existing packet-radio boards, such as the TAPR terminal node controller. At a meeting in West Germany, AMSAT DL, coordinator of the project, decided that the transponder should be usable by stations equipped with regular, unmodified amateur communications equipment. That includes the use of small to moderate size antennas to achieve low bit error rates.

The experiment has been named RUDAK for "*Regenerativer Umsetzer für Digital Amateur-Kommunikation*." Roughly translated, that means amateur radio digipeater.

The group agreed that link budget considerations should require efficient techniques for the downlink, which today can only be achieved using single-sideband equipment with demodulation at baseband, that is, at the audio stage. That limits the practical data rate to 1200 bits/s (RSM) or lower (BPSK). Performance of better than 12 dB Eb/No can be expected.

The uplink could use standard FM-equipment for conventional FSK modulation. Experiments by DB2ØS show that 2400-bits/s biphase transmission can be handled by standard equipment without problems. Still to be ascertained is whether 4800 bits/s (NRZ) also can be handled or if special measures, such as scrambling for spectrum shaping, are necessary to eliminate the influence of a DC-component. Higher data rates cannot be achieved with standard radios.

Because there currently is no suitable International Standards Organization (ISO) Layer-3 network definition available, the payload will emulate the existing digipeater function as defined in the version of the AX.25 protocol adopted in October 1984. If a more sophisticated Level-3 protocol becomes available, plans will be updated.

Both Mode-B and Mode-L uplink/downlink combinations were investigated but Mode-B was rejected because the expected downlink performance in the 2-m band was considered unsatisfactory in Japanese and European metropolitan areas. Also the lack of suitable spectrum space in the 2-m band, the bulk and cost of the required 2-m antenna, and the fact that a suitable transponder has already been built entered into the decision.

As now planned, the RUDAK transponder will have a 2400-bit/s uplink and a 400-bit/s downlink. The transponder will be a Mode L type with its receiver listening for signals at 24 cm and its transmitter set in the 70-cm band. Its beacon will operate continuously.

A bulletin-board will periodically send information packets containing such useful information as Keplerian data, the satellite's current position, and conventional status telemetry. RUDAK programs will be resident in random-access memory (RAM), facilitating software updates by AMSAT ground control stations.

Design constraints require that the experiment fit in a module measuring 300 by 200 by 40 mm, a P3 size box. Power consumption is limited to 5 W, volume to 5 liters, and mass to 5 kg. Recommendations for a standby mode with memory retention were made should the experiment draw more than 5 W.

Call for Papers Issued

AMSAT has issued a call for professional papers reporting original work and/or significant findings in the field of low-cost satellite engineering, space communications, space sciences, and related social-value issues.

Accepted papers will be published in the premiere edition of a new technical publication now slated for introduction in December. The publication will contain from 12 to 15 papers. Papers are due before August 1 and should be mailed to: AMSAT Technical Journal, P.O. Box 27, Washington DC 20044.

New Area Coordinators Tapped

Chief Area Coordinator Jack Somers, WA6VGS, has appointed a new group of area coordinators. In random order they are: Bill Parris, N5ARS, (Arkansas); Byron Lindsey, W4BIW, (Georgia); Frank Dzuirda, K7SFN, (northern Nevada); David Brunette, WA1AYT, (Maine); and John Low, K3JL, (Delaware). Named assistant coordinators were Tim Kearney, NZ4Q, (Indiana); Paul Beeman, KA2MUM, (Long Island, New York); and George Tew, NC5Y, (Mississippi).

Wanna Be In Pictures?

North Central California AMSAT coordinator Ross Forbes, WB6GFJ, would like to make you a star in his upcoming slide-show production. Ross is assembling as many 35-mm color slides as possible showing amateur satellite ground stations and the people who operate them. If the response is favorable, VHS and Beta video tapes will be produced and made available to the AMSAT Video Tape Library.

If you would like to be part of the production, send two or three good, clear slides. One should clearly show most of the station and, if possible, include you at the operating position. If necessary, send one slide of the equipment and another of the operator. One slide should show the OSCAR antenna system. And if you have been on an OSCAR DXpedition, include one or two slides of that.

Slides should be sent to Ross W. Forbes, WB6GFJ, AMSAT Coordinator for North Central California, P.O. Box 1, Los Altos, CA 94023. If there is enough interest, video tapes will be available in PAL and SECAM formats as well as the NTSC standard.

N2CF Departs as General Manager

In a short message to the AMSAT Board of Directors and officers, AMSAT executive director and general manager Bill Lazzaro, N2CF, announced his withdrawal from further direct involvement with the organization's business. In explaining his reason for leaving, Lazzaro cited his position with the ARRL, which he claims has the potential for a conflict of interest.

Lazzaro accepted the post of development manager for the ARRL in January. At that time he stepped down as one of AMSAT's two salaried employees. He had remained on, however, as nominal director and general manager.

AMSAT Managers Plan Gathering

An AMSAT Management Conference, similar to the one held in Ohio in early December, is in the planning stages in California. Newly appointed Area Coordinator WB6GFJ is in charge of the planning.

Orbital Elements

Satellite:		**oscar-9**	
Catalog number:		12888	
Epoch time:		85096.45071767	
	Sat Apr 6	10:49:02.6	1985 UTC
Element set:		745	
Inclination:		97.6273	deg
RA of node:		82.5009	deg
Eccentricity:		0.0003469	
Arg of perigee:		131.2995	deg
Mean anomaly:		228.8525	deg
Mean motion:		15.27129519	rev/day
Decay rate:		1.555e-05	rev/day^2
Epoch rev:		19428	
Semi major axis:		6859.501	km
Anom period:		94.294556	min
Apogee:		495.593	km
Perigee:		490.834	km
Ref perigee:		2652.47457279	
	Sat Apr 6	11:23:23.89	1985 UTC
Beacon:		145.8250	MHz

Satellite:		**oscar-10**	
Catalog number:		14129	
Epoch time:		85088.84421726	
	Fri Mar 29	20:15:40.371	1985 UTC
Element set:		167	
Inclination:		26.1822	deg
RA of node:		146.0091	deg
Eccentricity:		0.5980595	
Arg of perigee:		0.0300	deg
Mean anomaly:		0.1738	deg
Mean motion:		2.05858183	rev/day
Decay rate:		−7.3e-07	rev/day^2
Epoch rev:		1349	
Semi major axis:		26105.296	km
Anom period:		699.510692	min
Apogee:		35339.671	km
Perigee:		4114.631	km
Ref perigee:		2644.84398274	
	Fri Mar 29	20:15:20.108	1985 UTC
Beacon:		145.8100	MHz

Satellite:		**oscar-11**	
Catalog number:		14781	
Epoch time:		85094.61913766	
	Thu Apr 4	14:51:33.493	1985 UTC
Element set:		62	
Inclination:		98.2029	deg
RA of node:		161.3191	deg
Eccentricity:		0.0014672	
Arg of perigee:		93.0612	deg
Mean anomaly:		267.2313	deg
Mean motion:		14.61956704	rev/day
Decay rate:		9e-07	rev/day^2
Epoch rev:		5828	
Semi major axis:		7062.078	km
Anom period:		98.498129	min
Apogee:		715.185	km
Perigee:		694.462	km
Ref perigee:		2650.63676409	
	Thu Apr 4	15:16:56.417	1985 UTC
Beacon:		145.8260	MHz

Satellite:		**rs-5**	
Catalog number:		12999	
Epoch time:		85094.70048541	
	Thu Apr 4	16:48:41.939	1985 UTC
Element set:		231	
Inclination:		82.9667	deg
RA of node:		344.8842	deg
Eccentricity:		0.0008496	
Arg of perigee:		217.5568	deg
Mean anomaly:		142.4875	deg
Mean motion:		12.05049706	rev/day
Decay rate:		4e-08	rev/day^2
Epoch rev:		14505	
Semi major axis:		8033.856	km
Anom period:		119.497145	min
Apogee:		1670.363	km
Perigee:		1656.712	km
Ref perigee:		2650.66764041	
	Thu Apr 4	16:01:24.131	1985 UTC

Satellite:		**rs-7**	
Catalog number:		13001	
Epoch time:		85091.41562912	
	Mon Apr 1	09:58:30.355	1985 UTC
Element set:		198	
Inclination:		82.9654	deg
RA of node:		342.0018	deg
Eccentricity:		0.0021670	
Arg of perigee:		152.4003	deg
Mean anomaly:		207.8193	deg
Mean motion:		12.08692145	rev/day
Decay rate:		4e-08	rev/day^2
Epoch rev:		14509	
Semi major axis:		8017.697	km
Anom period:		119.137036	min
Apogee:		1661.448	km
Perigee:		1626.699	km
Ref perigee:		2647.45060280	
	Mon Apr 1	10:48:52.82	1985 UTC

Satellite:		**rs-8**	
Catalog number:		12998	
Epoch time:		85095.72789763	
	Fri Apr 5	17:28:10.355	1985 UTC
Element set:		313	
Inclination:		82.9651	deg
RA of node:		346.8867	deg
Eccentricity:		0.0018440	
Arg of perigee:		278.1657	deg
Mean anomaly:		81.7287	deg
Mean motion:		12.02952683	rev/day
Decay rate:		4e-08	rev/day^2
Epoch rev:		14492	
Semi major axis:		8043.196	km
Anom period:		119.705456	min
Apogee:		1700.522	km
Perigee:		1670.859	km
Ref perigee:		2651.70902539	
	Fri Apr 5	17:00:59.793	1985 UTC

Satellite:		**noaa-7**	
Catalog number:		12553	
Epoch time:		85071.65806892	
	Tue Mar 12	15:47:37.154	1985 UTC
Element set:		315	
Inclination:		99.0862	deg
RA of node:		52.4364	deg
Eccentricity:		0.0014132	
Arg of perigee:		61.2798	deg
Mean anomaly:		298.9786	deg
Mean motion:		14.13145626	rev/day
Decay rate:		2.19e-06	rev/day^2
Epoch rev:		19177	
Semi major axis:		7223.950	km
Anom period:		101.900326	min
Apogee:		872.051	km
Perigee:		851.633	km
Ref perigee:		2627.67006371	
	Tue Mar 12	16:04:53.504	1985 UTC
Beacon:		137.6200	MHz

Satellite:		**noaa-9**	
Catalog number:		15427	
Epoch time:		85095.77113854	
	Fri Apr 5	18:30:26.369	1985 UTC
Element set:		18	
Inclination:		98.9389	deg
RA of node:		49.8335	deg
Eccentricity:		0.0015362	
Arg of perigee:		310.4615	deg
Mean anomaly:		49.5219	deg
Mean motion:		14.11363673	rev/day
Decay rate:		4e-07	rev/day^2
Epoch rev:		1612	
Semi major axis:		7230.027	km
Anom period:		102.028983	min
Apogee:		875.069	km
Perigee:		852.856	km
Ref perigee:		2651.76139188	
	Fri Apr 5	18:16:24.258	1985 UTC
Beacon:		137.5000	MHz

Via Phil Karn, KA9Q

COMET AMSAT Chief Area Coordinator Jack Somers, WA6VGS, shows his neat satellite station at his Los Angeles area home.

Get to Know Your AMSAT Area Coordinator

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Barnard, David F.	W7LSV	9630 SW Alsea Dr.	Tualtin, OR 97062	Home (503) 692-1036 Work (503) 685-2274)
Beerman, Richard	N4EL	131 Westfield Rd.	Fanwood, NJ 07023	Home (201) 889-1873 Work - None -
Berman, Joseph H.	N8ATB	P.O. Box U	Athens, Ohio 45701	Home (614) 592-3931 Work - None -
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Kifer, Dave	N8ETY	3717 Woodway Ave.	Parma, OH 44134	Home (216) 459-0676 Work (216) 676-8300 Ext. 348
Knollinger, D. E.	WB8ZTV	RD 4 Box 230	Moundsville, WV 26041	Home (304) 845-1301 Work (304) 843-1310 Ext. 281
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Ley, Roger	WA9PZL	2514 Deas	Bossier City, LA 71111	Home (318) 746-0356 Work - None -
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Malin, Jerry	WB2LEI/4	709 Madras Lane	Charlotte, NC 28211	Home (704) 364-1635 Work (704) 584-6188

Marchal, Jerome	WA8RYD	270 W. Sharon Rd.	Cincinnati, OH 45246	Home (513) 772-0724 Work (513) 733-6558
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McKim, Jim	W0CY	1404 So. 10th	Salina, KS 67401	Home (913) 827-2927 Work - None -
McCaa, Wm. Jr.	K0RZ	P.O. Box 3214	Boulder, CO 80607	Home (303) 499-1936 Work - None -
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Means, Ed	W0VO	212 North Farragut	Colo. Springs, CO 80909	Home (303) 473-6174 Work - None -
Miller, Jay D.	WA5WHN	4613 Jupiter N.W.	Albuquerque, NM 67107	Home (505) 344-6734 Work (505) 345-3311 Ext. 3103
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Peterson, Stephen	KI7L	3791 S. 1860 East	Salt Lake City, UT 84106	Home (801 278-2727 Work - Same -
Power, Bruce	WD4HWO	1321 Nancy Drive	Tallahassee, FL 32301	Home (904) 877-3635 Work (904) 488-4318
Power, Ted	W1IAS	40 Massachusetts Ct.	Falmouth, MA 02540	Home (617) 548-1611 Work - None -
Roberts, Larry	W9MXC	3300 Fernwood	Alton, IL 62002	Home (618) 465-2735 Work (314) 233-4370
Rosen, Rick	K1DS	321 Taber Ave.	Providence, RI 02906	Home (401) 272-5626 Work (401) 331-3000
Roylance, Harry	W7RZY	216 So. M Street	Livingston, MT 59047	Home (406) 222-0655 Work (406) 222-0655
Ruhl, Richard	WD5GLD	P.O. Box 539	Kingfisher, OK 73750	Home (405) 375-4843 Work (405) 375-4111
Ruperto, E. F.	W3KH	RD 1 Box 366	West Alexander, PA 15376	Home (412) 663-5004 Work - None -
Schiers, Hasan A.	N0AN	Box 1024 Isu Stn.	Ames, IA 50010	Home (515) 434-2368 Work (515) 232-8405
Schroeder, Joe	W9JUV	P.O. Box 406	Glenview, IL 60025	Home (312) 724-8831 Work (312) 394-3380
Shepherd, Wm. R.	W4AUZ	325 Taylor Dr.	Lexington, KY 40505	Home (606) 254-4228 Work (606) 254-8542
Smith, Jim	KA7APJ	5717 N.E. 56th	Seattle, WA 98105	Home (206) 523-6167 Work (206) 523-5233
Soderman, R. G.	KW2U	43 Country Squire Rd.	Old Tappan, NJ 07675	Home (201) 666-2870 Work - None -
Somers, Jack	WA6VGS	P.O. Box 49751	Los Angeles, CA 90049	Home (213) 478-1717 Work (213) 820-1234
Stricklin, R. S.	N5BRG	2225 Arbor Crest	Carrollton, TX 75007	Home (214) 442-4218 Work - None -
Swafford, James	W7FF	5906 W. Miramar Drive	Tuscon, AZ 85715	Home (602) 298-7793 Work - None -
Traver, Ramon	WA2LJM	48 Carroll St.	Poughkeepsie, NY 12601	Home (914) 454-3249 Work - Same -
Welch, Roy D.	W0SL	908 Dutch Mill Road	Manchester, MO 63011	Home (314) 391-1127 Work (314) 247-5844
Wrensch, Tom	N9HR	N. 7900 Hillcrest St.	Oconomowoc, WI 53066	Home (414) 567-7382 Work (414) 691-0070 Ext 282
Wright, Ben	K9DID	1024 Whittier Drive	Appleton, WI 54911	Home (414) 739-8958 Work - Same -

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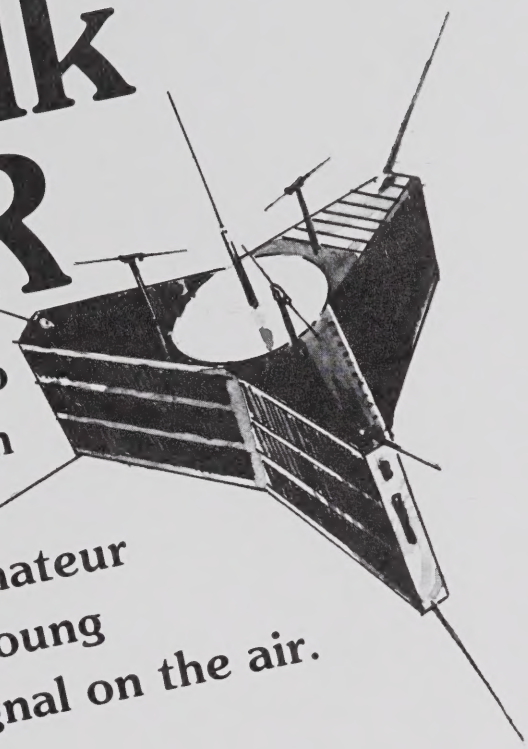

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